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PATENT SPECIFICATION

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(54) A LIGHTING INSTALLATION FOR HIGH POWERED ILLUMINATION

(71) We, COMMISSARIAT A L'ENERGIE ATOMIQUE, a French Company, of 29 Rue de la Federation, Paris 15e, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a lighting installation for high-power illumination. It is particularly applicable to lighting installations for use in buildings.

In situations where it is desired to produce high-powered illumination for artificial culture rooms or rooms producing simulated sunlight, or again where it is desired to illuminate large areas without multiplying the number of light sources (glasshouses, very high rooms etc.), it is necessary to utilise very powerful light sources. This power may, in some cases, reach as much as 20 kW per unit, and this is particularly the case with installations employing xenon discharge tubes.

It is well known in installations of this kind, that 80% of the installed power is dissipated in the form of heat. In order to keep the installation operating properly, it is therefore necessary to employ very effective cooling indeed. However, the deposition of dust upon the transparent parts of the installation, through which the light has to pass, brings about a very substantial reduction in the efficiency of the lighting installation.

Two main solutions have been proposed by which to overcome this problem. In the first of these, the arc tube is surrounded by a second tube through which cooling water circulates. This presumes either that an independent circuit containing double-distilled water, with piping arrangements, an exchanger and a stainless steel pump, is used, or that, if such precautions are not taken, daily cleaning in acid of the glass tubes surrounding the arc is carried out in order to eliminate the deposits contained within the cooling water.

A second solution consists in cooling the arc tube by air circulation. In this case, either forced circulation of filtered air is employed, in which case the air flow required is very considerable (for 6 kW lamp the throughput is in the order of 400 l/s), or the tube is cooled by natural convection in the room being illuminated. In the latter case, in view of the power of the installation, it is necessary to provide an air-conditioning system. In addition, both solutions lead to deposits upon the arc and filters, reducing the efficiency of the equipment and it is necessary to carry out frequent and careful cleaning.

The object of the present invention is to provide a lighting installation for high-power illumination for example powers in excess of 1 kW), which overcomes the aforesaid drawbacks whilst at the same time enabling efficient cooling of the lighting system to be achieved.

According to the invention, there is provided a lighting installation for high-power illumination, comprising a dustproof housing having one or more faces which permit the passage of light, the housing enclosing a light source and at least one heat-exchanger adapted to have cooling fluid passed through it and arranged to extract heat from a gas filling the housing.

In accordance with a preferred embodiment, the gas utilised is air and the liquid industrial water.

In accordance with another feature, the light source is a xenon arc tube.

The invention will be better understood from a consideration of the ensuing description which pertains to an embodiment of the invention given by way of non-limitative example. The description pertains to the attached figures in which:

Figure 1 is a side elevation of a ceiling lighting installation in partial section; and

Figure 2 is a sectional view of the ceiling installation in the plane AA of Figure 1.

A ceiling lighting installation in accordance with the invention comprises a housing 2, made for example of sheet metal and de-

[Price 25p]

limiting an enclosure protected from external dust. This housing need not be hermetically sealed, since this would over complicate its manufacture, and it is more economical to arrange for gentle scavenging of the enclosure by means of a low throughput of filtered air. The housing has a portion of parallelepiped shape, closed at its two ends, the right section of which is a half-decagon, having an open face 4 exhibiting a lengthwise enlargement 6. In this example, the open face 4 of the housing 2 is closed off by an assembly of rectangular glasses 8 through which light generated can pass. Inside the housing is an arc tube light source 10 arranged along the length of the housing 2, that is to say perpendicularly to the plane of Figure 2. This tube is fixed at each of its ends to the housing 2 by a known kind of mechanical support. At one of its ends, the tube 10 exhibits a set of electrical connections 12 passing in sealed fashion through the housing 2. These connections 12 are taken to an electrical supply arrangement, not shown in the figure. The housing 2 comprises two internal heat-exchangers 14 and 16. These heat-exchangers are attached to the internal wall of the housing. Each heat-exchanger is constituted by a length of piping 18 bent in such a fashion that it forms mutually parallel rectilinear sections such as those marked 20, arranged in one and the same plane and parallel to the axis of the arc tube 10. To facilitate heat exchange, the tubes 20 are provided with cooling fins 22 perpendicular to the tube axis. In a particular embodiment, the length of tube 18 is made of copper and the fins of aluminium. In addition, the lighting installation could comprise a different number of heat-exchangers, so long as at least one heat-exchanger is provided. This number depends both upon the power of the arc tube and upon the heat exchange area of each of the exchangers.

The installation furthermore comprises a reflector 24 having substantially the same contour as the housing 2. This reflector, however, has a slightly shorter length in order, at each of its ends, to leave passage between itself and the housing 2, and it may furthermore comprise, in order to facilitate air circulation, slots (not shown) located at its ends, above the tube 10. The reflector is, for example, attached to the exchangers 14 and 16 in such a fashion that it creates a passage 26 between itself and the housing 2. Each heat-exchanger of course has an input pipe for the cooling fluid, and a discharge pipe, respectively marked 28 and 30. The housing 2 additionally comprises an air input pipe 32, connected to a known kind of dust filter not shown in the figure. Around the ends of the tube 10, within the housing 2, there are small-diameter holes such as those marked 34.

The assembly of glasses 8 closing off the open face 4 of the housing 2, will advantageously be constituted by a plate 36 of glass acting as an infra-red filter, and by a second plate 38 of toughened glass. These plates 36 and 38 are attached to the housing 2 in dustproof fashion, by the use of seals such as those 40, located in a groove 42 formed in the wall of the housing and surrounding the open face 4 of said housing.

In this example, the housing 2 is surrounded by an enclosure 44 attached to the housing enlargement section 6. The enclosure 44 is suspended from the ceiling 46 by means of metal brackets such as those 48.

In the embodiment illustrated, the tube 10 is a long xenon discharge tube having an electrical power of 2 kW.

The operation of the installation will be readily apparent. Through each of the heat-exchangers 14 and 16, water is circulated which may be industrial water since these exchangers are located towards an opaque wall of the housing 2. Through the orifice 32, filtered air is introduced in order to create a slight superatmospheric pressure in said housing 2, and to renew the ozonised air which is discharged through the orifice 34. An internal circulation develops, by natural convection, between the heat source constituted by the tube 10 and the cold sink constituted by the heat exchangers 14 and 16. The quantity of air ozonised by the action of the light radiation and discharged through the orifices 34 is very small so that the throughput of filtered air passing through the orifice 32 is very tiny compared with that which would be required if the tube were cooled by air alone. In the case of the aforementioned tube, this throughput is in the order of 0.7 l/s. This is a particularly significant result since it is very difficult to remove dust from a substantial air throughput. In addition, the water utilised in the heat-exchanger can be industrial water and frequent cleaning is unnecessary. The water enters at 20°C and can leave at 60°C.

In the case where the power of the tube or tubes exceeds 3 kW, natural convection is no longer sufficient to dissipate the heat produced by the tube(s). As shown in Figure 2, the installation is then equipped with a fan in order to produce forced cooling. The fan 50 is arranged in the space contrived between the housing 2 and the reflector 24, and opposite the tube 10. It is driven by a small motor 52 attached to the external wall 44 of the device, the spindle 54 of the motor 52 passing in sealed fashion through walls 44 and 2. In the reflector 24, at least one opening such as that 56 is created. Depending upon the lighting power and the length of the tube, several uniformly spaced fans may be used.

The unit moreover comprises safety sys-

tems which have not been shown in the figures. On the one hand, there is a device which may for example be an electromagnetic relay, which cuts off the arc supply in the event of a defect in the water cooling circuit of in the event of an abnormal rise in temperature of the lighting installation (e.g. to above 130°C). On the other hand, a thermostat valve can be provided in the water circuit, in association with a heat sensor which detects the temperature in the housing 2 of the installation. In this fashion, a rough control of temperature is achieved, making it possible to reduce the water consumption.

The present invention is not limited to the particular example described and illustrated here, and the shape of the housing 2 for instance will depend upon the nature of the light source being cooled. Some other gas and some other fluid in the heat exchanger could be employed but it is of particular interest to utilise air and industrial water which are both especially inexpensive.

WHAT WE CLAIM IS:—

1. A lighting installation for high-power illumination, comprising a dustproof housing having one or more faces which permit the passage of light, the housing enclosing a light source and at least one heat-exchanger adapted to have cooling fluid passed through it and arranged to extract heat from a gas filling the housing.

2. An installation as claimed in claim 1, wherein the light source is an arc tube.

3. An installation as claimed in claim 2, wherein the light source is an xenon arc tube.

4. An installation as claimed in claim 2 or 3, wherein the housing is elongated along the axis of the tube; and is provided internally with a reflector defining between itself and opaque faces of the housing, a space within which the at least one heat-exchanger is located.

5. An installation as claimed in any of claims 1 to 4, comprising means for circulating industrial water through the at least one heat-exchanger.

6. An installation as claimed in any of claims 1 to 5, wherein the gas filling the housing is air.

7. An installation as claimed in claim 2, wherein the at least one heat-exchanger is constituted by parallel tubes interconnected by curved sections, said tubes being surrounded by cooling fins and being parallel to the axis of the arc tube.

8. An installation as claimed in any of claims 1 to 7, wherein the or each light-transmitting face of the housing is constituted by a plate of toughened glass and by a plate of glass which filters out infra-red radiation.

9. An installation as claimed in any of claims 1 to 8, comprising at least one fan arranged between said housing and a reflector therein, the reflector comprising at least one opening adjacent the light source.

10. A lighting installation for high-power illumination, substantially as herein described with reference to and as shown in the accompanying drawings.

For the Applicants:
GRAHAM WATT & CO.,
Chartered Patent Agents,
3/4 South Square,
Grays Inn,
London, W.C.1.

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1380020 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

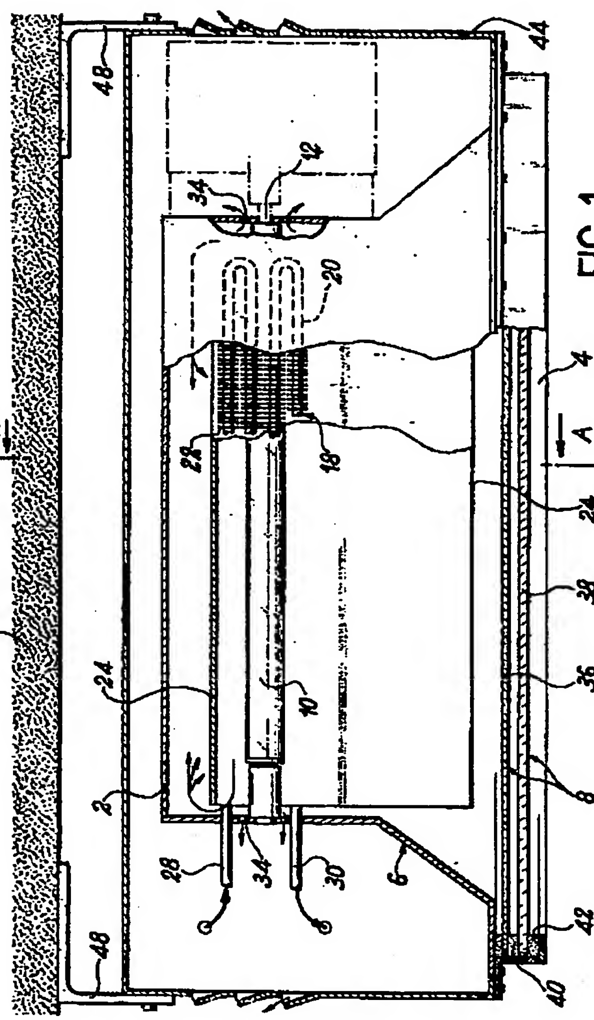

FIG. 1

1380020 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

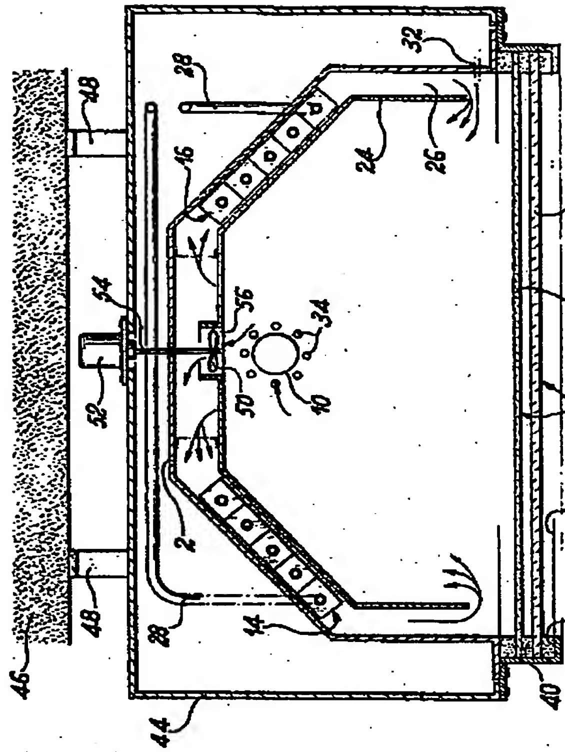

FIG. 2

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